
B. 2001 Kalamazoo River Recreational Angler Study

Executive Summary

The Kalamazoo River Recreational Angler (KRRRA) study was conducted for two reasons: (1) to obtain a current estimate of fishing use on the river, and (2) to conduct angler interviews of anglers who fish the river. This executive summary presents the most important results and conclusions of the KRRRA study.

The KRRRA study was implemented using a random on-site sampling procedure between May 27, 2001, and December 9, 2001. Aggregate use was estimated by weighting observed counts that were taken at 32 observation points by one survey agent during a randomly drawn subset of the total number of possible sampling periods. A correction based on external data was made for spring fishing outside of the sampling period. Two sampling methods were used for Allegan Dam, a popular and unique fishing site, because of the number of anadromous fish that congregate there.

Angler days were estimated for three reaches of the Kalamazoo River: upper – the confluence of Battle Creek to the waters above Morrow Lake Dam in Kalamazoo; central – the waters below Morrow Lake Dam through Lake Allegan (i.e., above Allegan Dam); and lower – the waters below Allegan Dam through Saugatuck Harbor. The upper reach is not part of the Kalamazoo River NRDA assessment area and received only about 8% of the total sampling time; estimates for this reach have low confidence. The angler day estimates are presented in Table S.1.

Table S.1. Estimated angler days on the reaches of the KRRRA study (spring through fall)

KRRRA study reach	Estimated annual number of angler days
Upper Kalamazoo	1,745
Central Kalamazoo	7,517
Lower Kalamazoo	19,416-20,193
All reaches	28,678-29,455

The angler interview was conducted with 94 predominantly shore anglers. The survey included 12 questions that collected information about the angler, the level of fishing activity and preferences, attitudes, and knowledge of FCAs. A summary of the results is provided below:

- ▶ A great deal of use occurs at Allegan Dam, and 59% of all angler interviews were conducted there.
- ▶ The majority of Kalamazoo River anglers are local residents (69% reported being residents of Allegan or Kalamazoo counties, which contain the KRE Superfund site).
- ▶ Anglers in the lower reach below Allegan Dam are more likely to be targeting specific species, anadromous species in particular, than anglers above the dam.
- ▶ Most Kalamazoo River anglers had not fished other sites in the two weeks previous to the interview.
- ▶ The single greatest dislike about the Kalamazoo River of central and lower reach anglers is visible pollution (e.g., paper waste, oil, trash).

Over half of interviewed anglers on the central and lower reaches either did not know about the PCB-caused FCAs or were uncertain of their content. Nonetheless, most anglers do not keep fish to eat; on average, only 3% of fish caught in the assessment area are eaten, which may reflect the sequencing of survey questions (see Appendix B, Section B.6). The popularity of catch-and-release may stem from FCAs and anglers' latent knowledge of FCAs.

B.1 Introduction

The primary purpose of the KRRRA study was to obtain current estimates of total angler use of the Kalamazoo River within the NRDA area. Before this survey, the most recent estimate of angler use on the Kalamazoo River was obtained by a 1985-1987 survey that did not incorporate stretches of the river located upstream of Allegan Dam (also known locally as “Caulkins”), omitting the most contaminated stretch upstream of this dam. The KRRRA study consisted of two elements: (1) a count of recreational anglers, both onshore and in boats; and (2) an on-site survey of recreational anglers that collected information on their level of fishing activity, preferences, attitudes, and knowledge of fish consumption advisories on the Kalamazoo River.

This appendix summarizes the design, implementation, and results of the KRRRA count study and a summary of the angler interview responses.

B.2 Design of the KRRRA Study

The KRRRA study took place between May 27, 2001, and December 9, 2001, and encompassed the stretch of the Kalamazoo River from the Battle Creek River to the Kalamazoo River’s confluence with Lake Michigan.¹ Predetermined weighting guided the selection of reaches for sampling and the allocation of sampling periods between weekdays and weekends, and the assignment of sampling periods within those categories (e.g., reaches and times of day) was randomized. The following subsections provide information on the selection of reaches for the individual sampling periods, the selection of observation locations, and the survey schedule.

B.2.1 Selection of reaches and observation locations for sampling

The KRRRA study was designed so each sampling period would provide a record of angler use and preference information within a distinct reach of the Kalamazoo River from Battle Creek to Lake Michigan. To accomplish this, this stretch of the Kalamazoo River was divided into the following three reaches: upper – the confluence of the Battle Creek River with the Kalamazoo River to the waters above Morrow Lake Dam in Kalamazoo; central – the waters below Morrow Lake Dam through Lake Allegan (i.e., above Allegan Dam); and lower – the waters below Allegan Dam through Saugatuck Harbor (see Figure B.1). In addition, sampling recorded angler use and preferences only at Allegan Dam from September 10 through December 9 for the fall steelhead run.

1. This schedule misses the spring season and the popular steelhead run that accompanies it. The KRRRA study adjusts for this omission using state data from 1986.

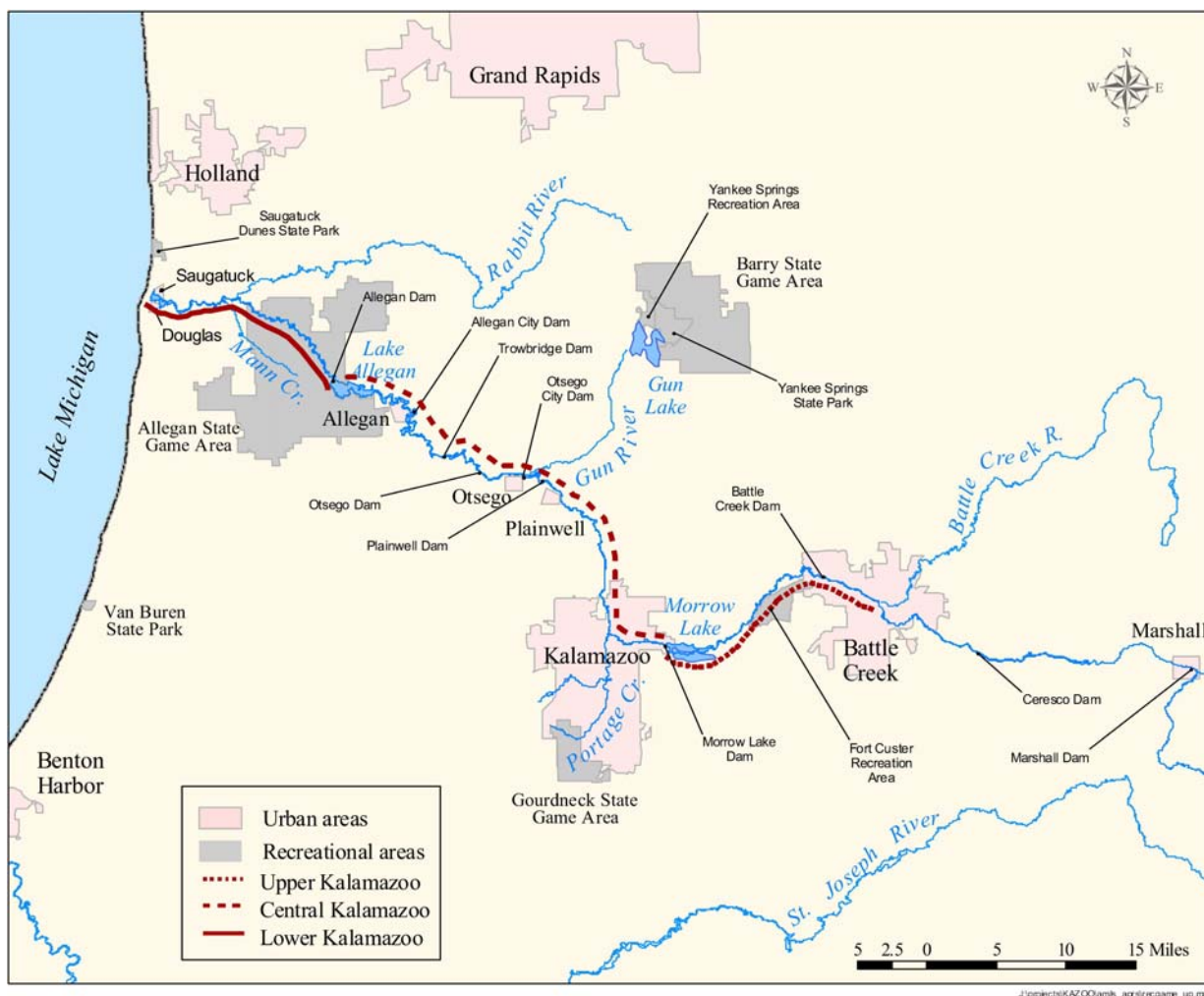


Figure B.1. Kalamazoo River.

The release of PCBs into the Kalamazoo River and into Portage Creek, a Kalamazoo River tributary that drains into the Kalamazoo River in the city of Kalamazoo below Morrow Lake Dam, has resulted in FCAs in the central and lower reaches of the Kalamazoo River (State of Michigan, 2001). The FCAs within the central reach are the most restrictive, recommending that males age 15 and older and women beyond childbearing age not eat any carp, catfish, suckers, or largemouth or smallmouth bass, and limit their cumulative consumption of other species to one meal a week. Women of childbearing age and all children less than 15 years old are advised to avoid consumption of any fish caught within the central reach.

In the lower reach, carp, catfish, and northern pike have “do not eat any” advisories for all individuals. Similarly, largemouth and smallmouth bass have a “do not eat any” advisory for women of childbearing age and children and an advisory of not more than “one meal per week” for adult males and women beyond childbearing age (State of Michigan, 2001). For all other species in the lower reach, adult males and women beyond childbearing age can enjoy unlimited consumption while women of childbearing age and children should limit themselves to no more than one meal per month (State of Michigan, 2001).

In addition to the differences in FCAs, the reaches defined for the KRRRA study reflect other differences in this stretch of the Kalamazoo River. Most important, Allegan Dam, the dividing line between the central and lower reaches, is currently an impassible barrier for anadromous species (e.g., salmon, steelhead). As a result, the lower reach has a different fish assemblage and pool of potential target species for anglers than the central and upper reaches. In addition, extensive public access for fishing off Allegan Dam provides angling opportunities in the lower reach not available in the central and upper reaches.

Counts of recreational anglers and angler interviews were completed at a series of fishing access sites and observation locations identified in a pretesting period. Within a reach, these locations were selected based on a combination of observed angler use and views of the river so that the entire length of the reach could be observed by visiting all the locations in a reach (i.e., from each observation location, there was overlap in the river and shoreline to the next observation location).² The observation locations used for the KRRRA study and the identification number assigned to each location (numbers increase within a reach moving downstream; latitude and longitude for each location are also provided) are presented in Table B.1 (nonconsecutive numbering in the central reach locations reflects the elimination of initially identified locations used during the pretesting).

This stretch of the Kalamazoo River is presented in Figure B.1. The break points between the reaches in the KRRRA study and several of the other locations are noted.

2. The Kalamazoo River can be viewed when in transit between points, so angler counts were continued from the road. Angling activity does not occur strictly at observation points; in the count summaries in this appendix, fishing pressure by observation point is based on the closest observation point.

Table B.1. KRRRA study observation and intercept locations by reach

Upper Kalamazoo River		Central Kalamazoo River		Lower Kalamazoo River	
Site I.D.	Site name (latitude, longitude)	Site I.D.	Site name (latitude, longitude)	Site I.D.	Site name (latitude, longitude)
101	S. Wattles Park (42.31736, -85.19048)	201	Morrow Dam (42.28307, -85.49486)	301	Allegan Dam/Caulkins Bridge (42.56368, -85.95452)
102	37 Trail (42.33792, -85.23277)	202	Morrow Lake (42.28304, -85.47196)	302	650 Area (42.58887, -85.97250)
103	2 River Junction (42.35650, -85.29937)	203	Morrow Park (42.28618, -85.51370)	303	Swan Creek Marsh (42.59295, -85.98213)
104	96 Bend (42.33527, -85.34485)	204	Wenke Park (42.28628, -85.53078)	304	Marsh Public Access (42.60225, -85.98788)
105	97 Area (42.33288, -85.34971)	205	Mills Bridge (42.29366, -85.56625)	305	Big Daily Bayou (42.61586, -86.00494)
106	Trailer Park Bend (42.28825, -85.40706)	206	Verburg Park (42.30333, -85.57175)	306	22 Junction (42.62832, -86.02756)
107	Gales Bridge (42.28048, -85.42897)	207	Mosel Bridge (42.31791, -85.57386)	307	Rabbit River Access (42.66047, -86.07248)
		208	Parchment Park (42.33242, -85.58307)	308	RR Junction (42.64197, -86.06841)
		209	D. Ave (Gravel Pit) (42.37602, -85.57877)	309	New Richmond (42.65203, -86.10703)
		210	Plainwell Dam (42.45560, -85.66933)	310	130th Access (42.63891, -86.16289)
		211	Otsego Dam (42.45874, -85.73365)	311	Douglas Bayou (42.64099, -86.19819)
		212	Trowbridge Dam (42.46548, -85.74763)		
		219	Monroe Rd. Bend (42.53810, -85.88293)		
		220	Lake Allegan (42.54706, -85.90763)		

Note: Nonconsecutive numbering in the central reach observation locations reflects the elimination of initially identified locations used during the pretesting.

B.2.2 Development of the KRRRA study sampling schedule

The KRRRA study sampling schedule includes the following features:

- ▶ The general schedule was four five-hour-long sampling periods per week (in the late fall some weeks included only three sampling periods); during a sampling period, the survey agent would conduct angler counts and angler interviews in only one reach (upper, central, or lower)
- ▶ During each sampling period, the survey agent visited each observation location in a given reach once and only once
- ▶ Weekdays and weekends received differential treatment (holidays are treated as weekends even if they fall on a weekday)
- ▶ A roughly equal allocation of sampling periods between weekends-holidays and weekdays was made (equal allocation was maintained in all weeks with four scheduled sampling periods)
- ▶ Sampling periods were randomly allocated across days and times within the weekday and weekend-holiday categories
- ▶ One survey agent was used for the entire study.

The KRRRA study was conducted in two phases. The first phase (Phase I), from May 27 through September 9, incorporated three possible sampling periods per day: 6 a.m. to 11 a.m. (morning); 11 a.m. to 4 p.m. (afternoon); and 4 p.m. to 9 p.m. (evening). The second phase (Phase II), from September 10 through December 9, had only two possible sampling periods because of the reduction in available daylight hours: 8 a.m. to 1 p.m. and 1 p.m. to 6 p.m.³ In addition, during Phase II, some sampling periods focused solely on recording the angling activity and preferences of anglers at Allegan Dam/Caulkins Bridge to record the anticipated increase in angler activity that coincides with the fall steelhead run.

The proportion of sampling periods conducted in each of the survey reaches by phase of the KRRRA study is presented in Table B.2.

3. The division of the KRRRA study into two phases reflects solely the restriction in sampling opportunities that resulted from the reduction in daylight hours as the study proceeded from summer to fall and early winter, as opposed to discrete changes in the characteristics of Kalamazoo River angling.

Table B.2. Final KRRR study reach sampling distribution

Survey subreach	Phase I (May 28 through September 9)	Phase II (September 10 through December 9)
Upper ^a	9.8%	5.9%
Central	44.3%	26.5%
Lower	45.9%	20.6%
Allegan Dam only	— ^b	47.1%

a. Because PCB-caused FCAs do not apply to the upper reach it was de-emphasized in the sampling plan.

b. In Phase I, there were no Allegan-Dam-only sampling periods; the Phase II sampling periods were scheduled to coincide with the fall steelhead salmon run.

Within a given week, the two weekend sampling periods were chosen at random over Saturday and Sunday, as were the sampling period times. Weekday sampling periods were determined by selecting two days at random from an equally weighted distribution of the weekdays for the first week of the sampling season (days “a” and “b”). In each subsequent week, the weekdays for the sampling periods were selected by advancing the day “a” sampling by one day and by moving the day “b” sampling back one day. An example of how this worked is provided in Table B.3.⁴

Table B.3. Example selection of weekday sampling periods for the KRRR study

Day “a” sampling periods		Day “b” sampling periods	
Week	Weekday	Week	Weekday
1	Tuesday	1	Friday
2	Wednesday	2	Thursday
3	Thursday	3	Wednesday

The selection of time of day for the weekday and weekend sampling periods in Phase I of the KRRR study was made at random for each of the days from an equally weighted distribution of the three available times. The direction of travel, either upstream or downstream, was also selected randomly for each sampling period. In Phase II of the study, restrictions in the field agent’s availability limited the weekday sampling times as shown in Table B.4, although the weekend sampling period times were still selected at random.⁵

4. In a few cases, day “a” and day “b” were the same. Two sampling periods were scheduled for those days, where the times of day were selected randomly.

5. The sampling design and methods used in this study are standard (see Kish, 1965; Cochran, 1977). Similar methods were used in a recent study to count California beach users (see Chapman and Hanemann, 2000).

Table B.4. Weekday sampling period times for Phase II of the KRRR study

Weekday	Available survey shift
Monday	Morning
Tuesday	Afternoon
Wednesday	Morning
Thursday	Afternoon
Friday	Afternoon

B.3 Implementation of the KRRR Study

The distribution of completed sampling periods by phase, observation location, and time and type of day is presented as counts and as percentages in Tables B.5 and B.6 for Phase I and Phase II of the KRRR study, respectively.

Tables B.5 and B.6 reflect the previously discussed distribution of sampling periods among the reaches for each phase of the KRRR study. Most notably, this results in a proportional reduction in the number of sampling periods in the central section in Phase II relative to Phase I so that increased Allegan Dam visits could be completed. This transition was appropriate in developing the sampling schedule because there is a shift in fishing activity to the Allegan Dam area in the fall that coincides with the seasonal steelhead run. Since the survey agent usually could visit all the observation locations within a reach during a sampling period, the angler count data provides a complete record for the reaches when they were visited.

There is a disproportionately large number of afternoon shifts for the central stretch in Phase I as a result of the randomization program. To have run the program repeatedly to obtain more even proportions would have interfered with the randomization process. The aggregation (weighting) procedure presented in Section B.5 takes account of the fact that there were relatively more afternoon shifts completed. The large number of afternoon sampling periods will not cause a bias; in fact, one would expect the estimates of afternoon angling to be more precise. To the extent that more angling occurs in the sampled reaches during the afternoon, this may be a benefit to the study.

Table B.5. KRRA study Phase I: Number of possible sampling periods and number of completed visits

Sampling period option	Weekday			Weekend			All		
	Morning	Afternoon	Evening	Morning	Afternoon	Evening	Morning	Afternoon	Evening
Possible sampling periods ^a	72	72	72	33	33	33	105	105	105
Upper Kalamazoo									
Number of completed sampling periods	2	0	0	1	1	2	3	1	2
Possible sampling periods completed (%)	2.8%	0.0%	0.0%	3.0%	3.0%	6.1%	2.9%	1.0%	1.9%
Central Kalamazoo^b									
Number of completed sampling periods	1	9	4	2	10	1	3	19	5
Possible sampling periods completed (%)	1.4%	12.5%	5.6%	6.1%	30.3%	3.0%	2.9%	18.1%	4.8%
Lower Kalamazoo^c									
Number of completed sampling periods	4	6	4	3	5	6	7	11	10
Possible sampling periods completed (%)	5.6%	8.3%	5.6%	9.1%	15.2%	18.2%	6.7%	10.5%	9.5%

a. Phase I lasted 15 weeks (May 28 through September 9, 2001). During this time there were three holidays (Memorial Day, 4th of July, and Labor Day) that fell on weekdays. These days are considered weekend days in the KRRA study. As a result the total number of weekdays is $72 = (15 \times 5) - 3$, and the total number of weekend days is $33 = (15 \times 2) + 3$.

b. In a few instances, not all of the observation locations were visited during a given sampling period, due to extenuating circumstances such as severe weather. In these cases, the sampling periods were only “partially” completed. Only three visits were made to the Plainwell Dam, Otsego Dam, Trowbridge Dam, Monroe Rd. bend, and Lake Allegan sites (site ids = 210, 211, 212, 219, 220, respectively) in the weekday evening sampling time period; only eight visits were made to the Otsego Dam (site id = 211) and Trowbridge Dam (site id = 212) in the weekday afternoon period; and no visits were made to the Otsego Dam and Trowbridge Dam sites in the weekend evening time period. As a result, the percentage of possible visits completed is 4.2% for the affected weekday evening sites, 11.1% for the Otsego and Trowbridge Dam sites in the weekday afternoon, and 0.0% for these same two sites for the weekend evening.

c. In a few instances, not all of the observation locations were visited during a given sampling period, due to extenuating circumstances such as severe weather. In these cases, the sampling periods were only “partially” completed. Only five visits were made to the Douglas Bayou site (site id = 311) in the weekday afternoon sampling time period. As a result, the percentage of possible visits completed is 6.9% for this site at this time.

Table B.6. KRRRA study Phase II: Number of possible sampling periods and number of completed visits

Sampling period option	Weekday		Weekend		All	
	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
Possible sampling periods ^a	64	64	27	27	91	91
Upper Kalamazoo						
Number of completed sampling periods	0	1	1	0	1	1
Possible sampling periods completed (%)	0.0%	1.6%	3.7%	0.0%	1.1%	1.1%
Central Kalamazoo						
Number of completed sampling periods	3	5	1	0	4	5
Possible sampling periods completed (%)	4.7%	7.8%	3.7%	0.0%	4.4%	5.5%
Lower Kalamazoo						
Number of completed sampling periods (Allegan Dam only)	1	3	4	8	5	11
Possible sampling periods completed (%) (Allegan Dam only)	1.6%	4.7%	14.8%	29.6%	5.5%	12.1%
Number of completed sampling periods (Allegan Dam as part of reach sampling) ^b	4	4	2	1	6	5
Possible sampling periods completed (%) (Allegan Dam as part of reach sampling)	6.3%	6.3%	7.4%	3.7%	6.6%	5.5%
Number of completed sampling periods (all other lower reach sites)	2	1	2	2	4	3
Possible sampling periods completed (%)	3.1%	1.6%	7.4%	7.4%	4.4%	3.3%

a. Phase II lasted 13 weeks (September 10 through December 9, 2001). During this time there was one holiday (Thanksgiving) that fell on a weekday (sampling was not done on the Friday following Thanksgiving). This is considered a weekend day in the KRRRA study. As a result the total number of weekdays is $64 = (13 \times 5) - 1$, and the total number of weekend days is $27 = (13 \times 2) + 1$.

b. The number of sampling periods completed to the Allegan Dam site as part of reach sampling is different from the remaining sites in the lower Kalamazoo reach because part way through Phase II the survey agent was directed to include the Allegan Dam location in sampling periods to the central Kalamazoo reach as well as the regularly scheduled (starting October 18) lower Kalamazoo reach sampling trips.

B.4 Raw Angler Counts

During a sampling period, the survey agent counted all visible shore and boat anglers at each observation location, and attempted to interview all accessible anglers.⁶ Tables B.7 and B.8 present the results of the sampling in terms of the number of observed anglers by observation location in Phase I and Phase II of the KRRRA study, respectively.⁷

Tables B.7 and B.8 together show that 1,124 anglers were observed during the KRRRA study: 438 (39%) during Phase I and 686 (61%) during Phase II. The higher totals in Phase II are consistent with *a priori* expectations of the increased sampling emphasis on the popular Allegan Dam location and the expected increase in angler activity in conjunction with the fall steelhead run.

A second conclusion from Tables B.7 and B.8 is that angling activity along the surveyed reaches of the Kalamazoo River is clearly not evenly distributed across the observation locations. For example, in the central and lower reaches, no anglers were ever observed, despite over 30 sampling periods, at two of the observation locations: Morrow Dam and RR Junction.

Table B.9 provides information on the three observation locations with the highest totals for observed anglers within each reach, including the total percentage of observed anglers in each phase of the KRRRA study that were seen at each of these locations.

Table B.10 provides additional information on the distribution of the observed anglers based on their fishing mode (i.e., boat or shore). Table B.10 shows that boating anglers constitute a significant portion of the total angler count in the KRRRA study (29%). As expected, the percentage of anglers in boats is higher during Phase I, which corresponds with the summer months. A surprising result in this table is the share of boat anglers that were observed in the central reach (50% over both phases), given conversations with local resource managers that portrayed the area as having limited boat access. While most of the observed boat angling was at Lake Allegan (62% of all observations), boat anglers were observed at 6 of the 13 fished observation locations within the central reach.

6. To be counted as a boat angler, an individual had to have visible fishing gear. Otherwise, he or she would be counted as a recreational boater.

7. Locations and times that were not sampled in the upper reach, identified as “not surveyed” in Tables B.7 and B.8, do not contribute to aggregate use estimates in the next section. This underestimate applies only to the upper reach, which is not in the assessment area, was not a main focus of the KRRRA study, and received less than 10% of the total sampling time. The upper reach estimates have low confidence in general, but serve to indicate that little fishing occurs there.

Table B.7. Anglers (shore and boat) observed during Phase I of the KRRA study

Site I.D. Observation location		Weekday			Weekend			All			Share of all anglers in Phase I observed at site
		Morning	Afternoon	Evening	Morning	Afternoon	Evening	Morning	Afternoon	Evening	
Upper Kalamazoo											
101	S. Wattles Park	3	Not surveyed	Not surveyed	0	0	0	3	0	0	1%
102	37 Trail	0	Not surveyed	Not surveyed	0	0	0	0	0	0	0%
103	2 River Junction	0	Not surveyed	Not surveyed	0	3	2	0	3	2	1%
104	96 Bend	0	Not surveyed	Not surveyed	0	0	0	0	0	0	0%
105	97 Area	0	Not surveyed	Not surveyed	0	0	0	0	0	0	0%
106	Trailer Park Bend	0	Not surveyed	Not surveyed	0	0	0	0	0	0	0%
107	Gales Bridge	0	Not surveyed	Not surveyed	0	0	0	0	0	0	0%
Upper Kalamazoo total		3	Not surveyed	Not surveyed	0	3	2	3	3	2	2%
Central Kalamazoo											
201	Morrow Dam	0	0	0	0	0	0	0	0	0	0%
202	Morrow Lake	0	3	9	1	9	1	1	12	10	5%
203	Morrow Park	0	0	0	0	1	0	0	1	0	0%

Table B.7. Anglers (shore and boat) observed during Phase I of the KRRRA study (cont.)

Observation location Site I.D.		Weekday			Weekend			All			Share of all anglers in Phase I observed at site
		Morning	After-noon	Evening	Morning	After-noon	Evening	Morning	After-noon	Evening	
Central Kalamazoo (cont.)											
204	Wenke Park	0	4	2	0	3	0	0	7	2	2%
205	Mills Bridge	0	0	1	0	0	0	0	0	1	0%
206	Verburg Park	0	0	0	0	1	0	0	1	0	0%
207	Mosel Bridge	0	0	0	1	0	0	1	0	0	0%
208	Parchment Park	0	1	0	0	0	2	0	1	2	1%
209	D. Ave (Gravel Pit)	0	8	1	0	5	0	0	13	1	3%
210	Plainwell Dam	0	4	0	0	4	3	0	8	3	3%
211	Otsego Dam	0	0	2	1	3	Not surveyed	1	3	2	1%
212	Trowbridge Dam	0	0	2	0	1		Not surveyed	0	1	2
219	Monroe Rd. Bend	0	3	3	1	1	0	1	4	3	2%
220	Lake Allegan	1	26	3	7	27	1	8	53	4	15%
Central Kalamazoo total		1	49	23	11	55	7	12	104	30	33%
Lower Kalamazoo											
301	Allegan Dam/ Caulkins Bridge	10	15	18	18	25	18	28	40	36	24%
302	650 Area	0	0	0	0	0	0	0	0	0	0%
303	Swan Creek Marsh	0	1	1	0	2	1	0	3	2	1%

Table B.7. Anglers (shore and boat) observed during Phase I of the KRRRA study (cont.)

Table B-7: Anglers (shore and boat) observed during Phase I of the Habitat Study (cont.)											
Observation location		Weekday			Weekend			All			Share of all anglers in Phase I observed at site
		Morning	Afternoon	Evening	Morning	Afternoon	Evening	Morning	Afternoon	Evening	
Site I.D.											
Lower Kalamazoo (cont.)											
304	Marsh Public Access	2	5	1	0	3	0	2	8	1	3%
305	Big Daily Bayou	1	6	0	0	2	4	1	8	4	3%
306	22 Junction	0	0	7	0	1	0	0	1	7	2%
307	Rabbit River Access	4	6	2	0	3	3	4	9	5	4%
308	RR Junction	0	0	0	0	0	0	0	0	0	0%
309	New Richmond	2	21	5	6	0	6	8	21	11	9%
310	130th Access	0	6	0	4	11	6	4	17	6	6%
311	Douglas Bayou	0	39	3	10	3	3	10	42	6	13%
Lower Kalamazoo total		19	99	37	38	50	41	57	149	78	65%
Total across all sites		23	148	60	49	108	50	72	256	110	100%
Total sampling periods		7	15	8	6	16	9	13	31	17	
Average anglers per visit		3.3	9.9	7.5	9.2	6.8	5.6	5.5	8.3	6.5	

Table B.8. Anglers (shore and boat) observed during Phase II of the KRRRA study

Observation location		Weekday		Weekend		All		Share of all anglers in Phase II observed at site
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	
Site I.D.								
Upper Kalamazoo								
101	S. Wattles Park	Not surveyed	2	0	Not surveyed	0	2	0%
102	37 Trail	Not surveyed	0	0	Not surveyed	0	0	0%
103	2 River Junction	Not surveyed	0	0	Not surveyed	0	0	0%
104	96 Bend	Not surveyed	1	0	Not surveyed	0	1	0%
105	97 Area	Not surveyed	0	0	Not surveyed	0	0	0%
106	Trailer Park Bend	Not surveyed	0	0	Not surveyed	0	0	0%
107	Gales Bridge	Not surveyed	0	2	Not surveyed	2	0	0%
Upper Kalamazoo total		Not surveyed	3	2	Not surveyed	2	3	1%
Central Kalamazoo								
201	Morrow Dam	0	0	0	Not surveyed	0	0	0%
202	Morrow Lake	2	5	1	Not surveyed	3	5	1%
203	Morrow Park	0	0	0	Not surveyed	0	0	0%
204	Wenke Park	0	0	0	Not surveyed	0	0	0%
205	Mills Bridge	0	0	0	Not surveyed	0	0	0%
206	Verburg Park	1	0	0	Not surveyed	1	0	0%
207	Mosel Bridge	0	0	0	Not surveyed	0	0	0%
208	Parchment Park	4	0	0	Not surveyed	4	0	1%
209	D. Ave (Gravel Pit)	2	2	0	Not surveyed	2	2	1%
210	Plainwell Dam	0	3	0	Not surveyed	0	3	0%

Table B.8. Anglers (shore and boat) observed during Phase II of the KRRRA study (cont.)

Site I.D.	Observation location	Weekday		Weekend		All		Share of all anglers in Phase II observed at site
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	
Central Kalamazoo (cont.)								
211	Otsego Dam	0	2	0	Not surveyed	0	2	0%
212	Trowbridge Dam	0	0	0	Not surveyed	0	0	0%
219	Monroe Rd. Bend	1	0	0	Not surveyed	1	0	0%
220	Lake Allegan	6	9	4	Not surveyed	10	9	3%
Central Kalamazoo total		16	21	5	Not surveyed	21	21	6%
Lower Kalamazoo								
301	Allegan-Dam-only visit	5	58	123	185	128	243	54%
301	Allegan Dam as part of reach surveys	51	56	58	15	109	71	26%
302	650 Area	0	0	4	0	4	0	1%
303	Swan Creek Marsh	0	2	0	0	0	2	0%
304	Marsh Public Access	0	0	1	0	1	0	0%
305	Big Daily Bayou	4	4	6	0	10	4	2%
306	22 Junction	1	0	1	0	2	0	0%
307	Rabbit River Access	4	0	5	1	9	1	1%
308	RR Junction	0	0	0	0	0	0	0%
309	New Richmond	6	5	3	9	9	14	3%
310	130th Access	0	0	0	0	0	0	0%
311	Douglas Bayou	4	7	9	12	13	19	5%

Table B.8. Anglers (shore and boat) observed during Phase II of the KRRRA study (cont.)

Site I.D.	Observation location	Weekday		Weekend		All		Share of all anglers in Phase II observed at site
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	
Lower Kalamazoo total		75	132	210	222	285	354	93%
Total across all sites		91	156	217	222	308	378	100%
Total sampling periods ^a		9	11	6	10	14	20	
Average anglers per visit		10.1	14.2	36.2	22.2	22.0	18.9	

a. The total number of sampling periods is calculated as the sum of the visits for the upper, central, and lower reaches plus those sampling periods that focused solely on the Allegan Dam site (see Table B.6). Because of the extra visits to the Allegan Dam site associated with sampling periods to the central reach, the average anglers per visit results presented above have an upward bias because these extra trips are not accounted for and because of the popularity of the Allegan Dam site.

Table B.9. KRRA frequently fished locations

Location name	Site I.D.	KRRA study reach	Percentage of Phase I anglers across all reaches	Percentage of Phase II anglers across all reaches
Lake Allegan	220	Central	15%	3%
Allegan Dam/ Caulkins Bridge	301	Lower	24%	80%
Douglas Bayou	311	Lower	13%	5%
Total			52%	88%

Table B.10. Mode of observed anglers by angling location, phase, and reach

KRRA study reach	Boat anglers	Shore anglers	Percentage of reach anglers in boats	Percentage of reach anglers on shore
Phase I				
Upper	0	8	0%	100%
Central	82	64	56%	44%
Lower	110	174	39%	61%
All reaches	192	246	44%	56%
Phase II				
Upper	0	5	0%	100%
Central	12	30	29%	71%
Lower	119	520	19%	81%
All reaches	131	555	19%	81%
Phase I and Phase II				
Upper	0	13	0%	100%
Central	94	94	50%	50%
Lower	229	694	25%	75%
All reaches	323	801	29%	71%

B.5 Aggregate Angler Days

The count of observed anglers in each phase of the KRRRA study provides the starting point for estimating the total aggregate level of angling activity measured in angler days that took place during the KRRRA study.⁸ From this starting point, separate adjustment factors are developed for the count of observed anglers for each phase to address the following sampling issues:⁹

1. Only a portion of the total number of possible sampling periods was covered by the survey agent.
2. On any given sampling period, some anglers were not observed because each observation location was visited once, allowing anglers to arrive at a location after the survey agent had completed her visit or to leave before her arrival.

Adjusting the counts of observed anglers in response to the first sampling issue is straightforward and requires multiplying the observed counts at a location, distinguished by phase, type of day, and sampling time, by an adjustment factor equal to the inverse of the percentage of trips completed to observation locations out of the total possible number of sampling periods (see Tables B.5 and B.6 for these percentages).¹⁰

This adjustment increases angler counts by a factor of roughly 11.5 for Phase I and 9.6 for Phase II. To simplify the reporting, the adjusted counts by location have been aggregated by reach and sampling time in Table B.11 (counts for Allegan-Dam-only sampling periods in Phase II are reported separately).

The counts of anglers in Table B.11 represent only the first adjustment in estimating total angler use during the KRRRA study. The final estimate is obtained after accounting for the fact that the survey agent did not observe the entire reach for the entire duration of a sampling period.

The second set of adjustment factors incorporates information from the KRRRA study's angler intercept results. Separate adjustment factors are calculated by reach (upper and central receive the same adjustment) for the weekday and weekend counts in each phase of the KRRRA study consistent with the aggregation in Table B.11.

8. If one angler fishes for any part of one day, that is an "angler day."

9. Separate adjustment factors are required for each phase of the KRRRA study because of the difference in the number of sampling periods in each phase and the addition of the sampling periods that focused only on Allegan Dam in Phase II.

10. For example, if 20 anglers were observed at a location that was visited 6 out of a possible 60 times (10%), the adjusted angler count for the location would be 200 (i.e., $20 \times [1/0.10]$).

Table B.11. KRRRA study angler counts after adjustment for portion of possible sampling periods covered

Phase I								
Reach	Weekday morning	Weekday afternoon	Weekday evening	Weekday total	Weekend morning	Weekend afternoon	Weekend evening	Weekend total
Upper	108	Not surveyed	Not surveyed	108	Not surveyed	99	33	132
Central	72	392	474	938	182	182	231	594
Lower	342	1,282	666	2,290	418	330	226	974
Total all reaches				3,336	Total all reaches			1,700
Phase II								
Reach	Weekday morning	Weekday afternoon	Weekday total	Weekend morning	Weekend afternoon	Weekend total		
Upper	Not surveyed	192	192	54	Not surveyed	54		
Central	341	269	610	135	Not surveyed	135		
Lower	1,424	2,048	3,472	1,175	702	1,877		
Allegan-Dam-only	320	1,237	1,557	830	624	1,445		
Total all reaches				5,831	Total all reaches			3,521

For a given sampling period, the likelihood of an angler being observed is based on the amount of time the angler is fishing as a proportion of the total duration of the sampling period for the whole reach. Intuitively, the longer the angler is fishing, the more likely it is the survey agent will observe the angler as the survey agent makes the round through all the observation points within the reach.

Suppose for the sake of simplicity and illustration that the length of the sampling period is two hours, and all anglers report a fishing duration of one half hour. Because the duration of an angler's visit is 25% of the duration of the sampling period (30 minutes/120 minutes), it is inferred that on average anglers have a one in four chance of being observed by repeated visits conducted on different days during the two-hour sampling period. On average, the survey agent will miss 75% of the anglers, because they only fish for a portion of the sampling period. Thus, the weight to be used for observed anglers is a factor of four, the reciprocal of the likelihood of observing an angler ($1/0.25$).

Generally, let T = the length of the sampling period, and t_i be the fishing duration of angler i . The likelihood of observing angler i is t_i/T , and an estimate of the adjustment factor for aggregation based only on angler i 's data is the reciprocal of this expression, T/t_i . Estimates of t_i are reported

from numerous anglers from the on-site angler interview (Question 5). The variable t_i is the total time anglers reported for their fishing visits. T in all cases is equal to 5 hours. The mean of the expression T/t_i over i is used as the weight (adjustment factor), as reported in Table B.12:

$$W = \left[\frac{T}{t_i} \right] = T \times \frac{\sum_{i=1}^N \left[\frac{1}{t_i} \right]}{N}. \quad (\text{B.1})$$

The adjustment factors are therefore the inverse of the ratio of the harmonic mean of fishing time to the duration of the sampling period (R. Tourangeau, Director of the Joint Program of Survey Methodology, University of Maryland, personal communication, January 29, 2004).¹¹

The interim adjusted counts in Table B.11 by phase and type of day are multiplied by the adjustment factors in Table B.12, with the exception of the interim counts in Table B.11 for the sampling periods at Allegan Dam.

The counts for Allegan Dam in Table B.11 are not adjusted using this approach because the survey agent was able to record all of the anglers who were at the site during the sampling period because she was stationed there. As a result it would be inappropriate to apply this type of adjustment, which is designed to account for anglers missed because the survey agent visited each observation location only once during a sampling period. Instead, the Allegan Dam counts reported in Table B.11 were increased by multiplying by an adjustment factor equal to the actual length of each sampling period (5 hours) divided by the time actually spent at Allegan Dam on these shifts (3 hours). The resulting adjustment factor of 1.67 accounts for the fact that not all the time in the sampling period was spent on site at Allegan Dam but that, while the agent was there, no Allegan Dam anglers were missed.¹²

11. The harmonic mean is the number of observations of a variable, divided by the sum of the reciprocals of that variable. When this weighting method has been applied in the literature, it is described in terms of the harmonic mean [see Tourangeau and Ruser, 1999; see also Dixon and Chapman (1980) for another application using the harmonic mean], but the computations here are equivalent. Both the arithmetic and harmonic means of t are reported in Table B.12. As an aside, the harmonic mean is less than the arithmetic mean because the harmonic mean is much less sensitive to outlier observations. The adjustment factors are based on the mean of the inverse of angler fishing time, not the mean of fishing time (see Equation B.1), so the harmonic mean of fishing time is the appropriate statistic.

12. This factor is appropriate assuming fishing start and stop times are random and, based on the survey information, the length of the average fishing day is short relative to the length of a sampling period. Also, note that these Allegan Dam sampling periods are not part of lower-reach sampling, so anglers fishing at or near other lower observation points are not of concern.

Table B.12. Adjustment factors to account for anglers missed during sampling periods

	Phase I		Phase II	
	Weekday	Weekend	Weekday	Weekend
Arithmetic mean of expected duration of fishing visits (hours)	2.30	2.33	2.07	2.30
Harmonic mean of expected duration of fishing visits (hours)	1.79	1.81	1.85	1.69
Central and upper reach adjustment factors				
Sampling period duration in central and upper reaches (hours)	5.00	5.00	5.00	5.00
Harmonic mean of time spent fishing divided by sampling period duration in central and upper reaches (hours)	0.36	0.36	0.37	0.34
Adjustment factor	2.79	2.77	2.70	2.96
Lower reach adjustment factors				
Sampling period duration in lower reach visits (hours)	5.00	5.00	5.00	5.00
Sampling period duration for Allegan Dam only visits (hours)	3.00	3.00	3.00	3.00
Harmonic mean of time spent fishing divided by sampling period duration in lower reach (hours)	0.60	0.60	0.62	0.56
Adjustment factor	1.68	1.66	1.62	1.78

Some figures are rounded for presentation.

The resulting final estimates of angler days on the reaches incorporated in the KRRRA study are presented in Table B.13. Note that because of the two sampling methods for Allegan Dam, there is a range for the lower reach.

Table B.13 presents a final angling estimate of roughly 21,900 to 22,400 angler days on the surveyed reaches of the Kalamazoo River during the KRRRA study. Of this total, roughly 66% of the days (i.e., 14,200-14,700 days) are estimated to occur in the lower Kalamazoo River reach, which is consistent with expectations because of the ease of access and congregation of desirable recreational angling species (e.g., salmon, steelhead) in this reach.¹³

13. The range in estimates is driven by the two sampling methods for Allegan Dam. This count study was designed to provide order-of-magnitude estimates of the level of use. The smaller scale of this study, with only one survey agent and a small percentage of total possible sampling periods covered, contributes to a wider range of uncertainty in the estimates. The larger estimate is based on weights derived from data collected at all observation points; Allegan Dam is a unique site, and the turnover rate may be different from other, less-popular sites. Further, the weights are based on a limited amount of data, so there is uncertainty in the weights as well. In a more intensive study, the two estimates would be expected to converge. Because FCAs are milder below Allegan Dam, and apply only to warm-water fishing days (see Chapter 2), the difference in the use estimates below the dam is less significant with respect to the damage estimates.

Table B.13. Estimated angler days during the KRRRA study

KRRRA study reaches	Phase I		Phase II	
	Weekday	Weekend	Weekday	Weekend
Upper Kalamazoo	302	365	518	160
Central Kalamazoo	2,621	1,643	1,646	400
Lower Kalamazoo	3,839	1,616	5,445-5,621	3,336-3,648
Total all reaches	6,762	3,625	7,609-7,785	3,896-4,208
Total all reaches all phases		21,892-22,380		
Figures may not sum to totals due to rounding.				

The KRRRA study covered 197 days, or 54% of the year. However, extrapolating to annual use is complicated by the fact that fishing effort is not equally distributed over the year, especially in the winter months, when the weather limits the number of attractive locations and the number of possible days to fish.

The KRRRA study effectively covered the summer and fall fishing seasons, leaving the winter and spring unaccounted. Available information from a 1986 creel survey conducted at Allegan Dam (J. Wesley, MDNR Fisheries Division, personal communication, 2002) showed that visits to the location in the spring were 59% of those in the fall.¹⁴ Assuming that this is reflective of all the reaches in the KRRRA survey, the Phase II aggregate counts, which effectively represent the fall season, are inflated by 1.59 (i.e., an additional 59%) to account for spring visits. Despite the knowledge that fishing does occur at locations along the surveyed reaches of the Kalamazoo River in winter, notably for walleye downstream of Allegan and Trowbridge Dams (J. Wesley, MDNR Fisheries Division, personal communication, 2002), no adjustment was incorporated for the winter season because of a lack of information on which to base any adjustment factors.

Table B.14 presents the estimated angler days for spring through fall for each reach of the KRRRA study incorporating the annual adjustment factor described above while maintaining a range of estimates for the lower reach to reflect the differences in the estimating approaches.

As presented in Table B.14, incorporating the spring adjustment provides an estimate of between 28,700 and 29,500 angler days from spring through fall on the reaches of the Kalamazoo River included in the KRRRA study.

14. In this study, spring includes March, April, and May (and therefore ends just as the sampling began), and fall includes September through December (and so matches the Phase II period closely).

Table B.14. Estimated angler days spent fishing in the reaches of the KRRRA study (spring through fall)

KRRRA study reach	Estimated number of angler days
Upper Kalamazoo	1,745
Central Kalamazoo	7,517
Lower Kalamazoo	19,416-20,193
All reaches	28,678-29,455

B.6 Results of the KRRRA Angler Interview

The angler interviews of the KRRRA study were implemented during the same sampling periods as the counts of anglers. Efforts were made to interview all reasonably accessible anglers at locations that did not involve entering posted private property. Over the course of the KRRRA study, 94 angler intercepts were completed (59 in Phase I and 35 in Phase II). A copy of the survey questionnaire administered by the survey agent is included as Figure B.2.

Of the completed interviews, seven anglers were interviewed more than once. The responses to all interviews are considered to have been completed within the KRRRA study period because much of the collected information is specific to the actual angling event rather than the angler. The responses from the repeat group to questions about angling preferences may cause a slight bias as a result, but the impact should be minimal.

Summaries of the angler interview results are presented in Tables B.15 through B.33, following the order of the survey questions in Figure B.2. These tables appear at the end of this section.

From among the various findings in the intercept data, the following are of special interest or worthy of special note.

- Of the 94 completed surveys, 55 (59%) were completed at Allegan Dam (see Table B.16). As a result, responses to questions that are not broken out by reach are heavily influenced by these responses. At the same time, the total number of responses from anglers interviewed in the lower reach is not disproportionate to the final distribution of angling days during the study (77% of survey responses versus 79% of estimated angling days).

KALAMAZOO RIVER ANGLER INTERCEPT SURVEY

ID# _____

DATE: ____/____/2001 TIME: ____ am / pm DAY OF WEEK: M T W Th F Sa Su

River Stretch: 1 = Upper 2 = Central 3 = Lower Site Code #: _____

Rain/Bad Weather: 0 No 1 Yes Angler Type: 0 Shore 1 Boat

HELLO, MY NAME IS HEATHER. I'M WORKING WITH THE U.S. FISH AND WILDLIFE SERVICE TO COLLECT INFORMATION ABOUT FISHING, INCLUDING THIS PART OF THE KALAMAZOO RIVER.

#1 COULD I ASK YOU A FEW SHORT QUESTIONS ABOUT YOUR FISHING ? 0 – No 1 – Yes

#2 HAVE I INTERVIEWED YOU BEFORE TODAY? 0 = No 1 = Yes (If YES When? _____)

#3 WE WOULD LIKE TO KNOW HOW FAR ANGLERS TRAVEL TO FISH THE KALAMAZOO RIVER.
CAN WE HAVE YOUR HOME TOWN AND ZIPCODE? City: _____ Zip Code: _____

#4 WHAT PRIMARY SPECIES ARE YOU TARGETING? (circle all that are mentioned)

a) Trout b) Salmon c) Walleye / Pike d) Perch / Bluegill / Sunfish
e) Bass f) Carp-Catfish-Sucker g) Whatever is biting h) Other _____

#5 HOW LONG HAVE YOU BEEN FISHING AT THIS SITE TODAY? _____ hrs _____ mins

#6 HOW MUCH LONGER DO YOU EXPECT TO BE FISHING HERE TODAY? _____ hrs _____ mins

#7 HOW MANY ANGLERS ARE IN YOUR PARTY TODAY, INCLUDING YOURSELF? _____ # anglers

#8 INCLUDING TODAY, HOW MANY DAYS HAVE YOU FISHED IN THE PAST TWO WEEKS EITHER HERE OR ANYWHERE ELSE? _____ Days

HOW MANY OF THESE DAYS FISHING WERE TO:

- The Kalamazoo River from Battle Creek to above Morrow Dam _____ Days
- The Kalamazoo River from below Morrow Dam to above Caulkins Dam (including Lake Allegan) _____ Days
- The Kalamazoo River from below Caulkins Dam to Lake Michigan _____ Days
- Kalamazoo River tributaries (e.g., Rabbit River, Gun River, Battle Creek) _____ Days
- Other site(s) (if mentioned _____) _____ Days

#9 (Central and Lower reaches only – Morrow Pond to Lake Michigan).
THINKING ABOUT THE KALAMAZOO RIVER BETWEEN MORROW POND AND LAKE MICHIGAN ARE THERE THINGS THAT YOU PARTICULARLY LIKE OR DISLIKE ABOUT FISHING HERE (for both circle # and add comments)?

Like 1 = Convenience / Close to home Dislike 21 = Consumption restriction
2 = Uncongested 22 = PCBs
3 = Good Accessibility (e.g., boat launches) 23 = Other visible pollution (e.g., paper waste, oil, trash)
24 = Limited access/facilities

Other Like = _____ Other Dislike = _____

#10 ARE YOU AWARE OF ANY ADVISORIES OR RESTRICTIONS ON FISH CONSUMPTION FOR THIS STRETCH OF RIVER?

0 = No
1 = Yes -----> What do you understand the advisory in this stretch of the river to be?
9 = Thinks so, but uncertain _____

#11 OVER THE PAST 12 MONTHS, ABOUT WHAT PERCENTAGE OF THE FISH THAT YOU CAUGHT ON THE KALAMAZOO AND COULD HAVE KEPT, WERE KEPT FOR EATING, EITHER BY YOURSELF OR OTHERS?

None 10% 20% 30% 40% Half 60% 70% 80% 90% All (circle closest percent)

#12 TO BETTER MANAGE THE KALAMAZOO RIVER, WE MAY WANT TO CONTACT YOU BY MAIL OR PHONE. WOULD YOU BE WILLING TO HELP?

0 No --> Thank respondent for taking the time to complete the questions. <<TERMINATE INTERVIEW>>
1 Yes --> Add name, address, city, zip code, telephone number on separate record sheet.

INTERVIEWER ADD FOLLOWING INFORMATION ABOUT RESPONDENT:

GENDER: 0 = Male 1 = Female AGE Group: 0 = Youth 1 = Adult 2 = Senior

DOES THE ANGLER POSSESS ANY FISH? 0 = None visible 1 = Yes

COMMENTS:

Figure B.2. Kalamazoo river angler interview.

- ▶ Results presented from intercepts conducted in the upper reach of the KRRRA study must be viewed and interpreted with caution as a result of the limited size of the respondent pool (three angler intercepts, see Table B.16).
- ▶ The survey responses come disproportionately from shore anglers relative to boat anglers (see Table B.18) compared to the counts of observed anglers (see Table B.10).

While 29% of the observed anglers in the KRRRA study were in boats (Table B.10), only 12% of the completed interviews were from boat anglers. This result was anticipated and is largely unavoidable in this type of survey given the difficulty in interviewing boat anglers with a shore-based survey agent. Adjustments that attempt to account for this discrepancy were not developed.

- ▶ A majority of the anglers are local residents (Table B.19).

About 68% of the respondents report living in a city or town within Allegan (Allegan, Fennville, Pullman, and Saugatuck) or Kalamazoo (Galesburg, Kalamazoo, and Portage) counties, the principal counties containing the reaches included in the KRRRA study. Many of the remaining respondents come from counties adjacent to these counties.

- ▶ Anglers in the lower reach are more likely to be targeting specific species than are anglers in the other reaches (see Table B.21).

A higher percentage of anglers surveyed in the lower reach report targeting a specific species than do anglers surveyed in the central reach, as reflected in the percentage of respondents who responded affirmatively when questioned if they were interested in “whatever bites.” This result can also be seen in the high percentage of lower reach respondents who reported targeting salmon. This result is expected given the fish assemblage potentially available in the lower reach. Specifically, because Allegan Dam represents an impassible barrier to anadromous species (e.g., salmon and steelhead), these fish end up congregating below the dam, making it a desirable fishing location, especially when combined with the existing public access opportunities.

- ▶ Most Kalamazoo River anglers had not fished other sites in the past two weeks at the time of the interview (see Table B.24).

Table B.24 shows that most of the interviewed anglers reported no fishing days within the previous two weeks at any other nearby rivers and lakes, although the table also shows that a significant number of these anglers took multiple fishing days within the two-week period (almost all of which were to the Kalamazoo River). Most notably, the group of nearby locations includes the Rabbit River, which is unique for the area because it is a Class I trout stream. This finding suggests there is a group of anglers that consistently chooses to fish the surveyed reaches

of the Kalamazoo River. However, a two-week period is short and allows few opportunities to visit other sites. Further, during any one period of time, anglers may focus on one particular site.

- ▶ The single greatest dislike about the Kalamazoo River of central and lower reach anglers is visible pollution (e.g., paper waste, oil, trash – see Table B.26).

Interviewed anglers in the central and lower reaches of the KRRRA study were approximately three times more likely to cite visible pollution as their greatest annoyance while angling than to cite PCB contamination. This suggests that, among active anglers, addressing the PCB contamination may not be the first priority in terms of improvements that could be made to improve fishing conditions. However, this finding does not address the extent to which the PCB contamination may have driven other anglers away from these reaches of the Kalamazoo River altogether.

- ▶ The majority of the interviewed anglers report little knowledge about the PCB-caused FCAs on the central and lower reaches of the Kalamazoo River (see Table B.28).

Table B.28 shows that in the central and lower reaches of the KRRRA study, over half of the interviewed anglers either did not know about the PCB-caused FCAs or were uncertain of their content. That this is the case in the central reach is of concern, given the severity of the FCAs in this reach, and the efforts that have been and continue to be taken to inform the angling public.

Two other studies show awareness to be considerably higher, but those results must be qualified, as they are not directly comparable to this finding. Atkin (1995), first mentioned in Table 2.1, reports that over two-thirds of anglers in the eight counties surrounding the Kalamazoo River are aware of Michigan FCAs, but only 25% mentioned the Kalamazoo River in an open-ended question about specific sites. Also, the Atkin fishing log data for anglers are incomplete for the year, and consequently it is not possible to determine who had fished the Kalamazoo River over the past year, or how frequently they have fished there. It is likely many of these anglers had substituted away from the Kalamazoo River, reflecting a higher awareness of FCAs. Atkin (1998) reports that 81% of anglers who had fished the Kalamazoo River in the past year were aware of Kalamazoo River FCAs (and 57% had full or partial knowledge of the kinds of fish posing the most risk). However, this figure is based on a small sample size (37 anglers) and a leading question: “Have you heard the advisory warning about eating fish from the Kalamazoo River?” This question also follows other questions discussing Kalamazoo River contamination. Finally, while these anglers are Kalamazoo River anglers, they are likely to be less avid about Kalamazoo River fishing than those intercepted in the KRRRA study, because those who are more avid are more likely to be intercepted. The Atkin (1998) study was based on a random telephone survey.

- The low percentage of fish caught that are kept and eaten may reflect a latent knowledge of FCAs (see Tables B.29 and B.30).

In the central reach of the KRRRA study, where the PCB consumption advisories are most restrictive, on average only 3% of fish that are caught are eaten. Thirteen of the 18 respondents (72%) in this reach replied that they do not eat any of their catch, and the maximum response was that 20% of the catch was eaten. In contrast, on average 15% of the catch in the lower reach was reported to be eaten, with under half of the 73 respondents replying that they ate none of their catch. However, these lower reach statistics are more difficult to interpret with regard to effective compliance with the FCAs because the consumption restrictions are less severe relative to the central reach, particularly with regard to the popular anadromous species.

It is unclear why so few people report keeping many fish to eat, given the low-to-moderate awareness of FCAs. When the survey agent followed up with individuals who were unaware of the FCAs, but still do not keep many fish, several said they were catch-and-release anglers who do not fish for food. Others may be underreporting how many fish they keep because of the sequencing of the survey questions (this question is immediately preceded by a question about FCAs, suggesting that eating fish is not a good idea), or they may be underreporting their knowledge of FCAs. It is not expected that the small numbers of fish kept and eaten is the result of bag limits or minimum size restrictions because of how the question was posed (i.e., “caught and could have kept”).

The FCAs in the lower reach include no restrictions for adult males and women beyond childbearing years and a one meal per month restriction for everyone else on the consumption of salmon, which is the most highly targeted species among anglers in this reach (see Table B.21).

Table B.15. Day of interview

Type of day	Frequency	Percent
Weekday	42	45%
Weekend	52	55%

Table B.16. Location of interview

Site I.D.	Site name	Frequency	Percent
101	S. Wattles Park	1	1.1%
103	2 River Junction	1	1.1%
107	Gales Bridge	1	1.1%
202	Morrow Lake	4	4.3%
208	Parchment Park	2	2.1%
209	D. Ave (Gravel Pit)	1	1.1%
210	Plainwell Dam	1	1.1%
211	Otsego Dam	3	3.2%
212	Trowbridge Dam	1	1.1%
219	Monroe Rd. Bend	4	4.3%
220	Lake Allegan	3	3.2%
301	Allegan Dam/ Caulkins Bridge	55	58.5%
303	Swan Creek Marsh	1	1.1%
304	Marsh Public Access	2	2.1%
305	Big Daily Bayou	2	2.2%
307	Rabbit River Access	3	3.2%
309	New Richmond	6	6.4%
310	130th Access	2	2.1%
311	Douglas Bayou	1	1.1%

Figures may not sum to 100% due to rounding.

Table B.17. Rain/bad weather

Was it raining/bad weather for interview?	Frequency	Percent
No	94	100%
Yes ^a	0	0%

a. Although no angler interviews were conducted during bad weather, the survey agent reported bad weather on 18% of all survey shifts. Of the total anglers observed, only 8% were fishing during bad weather. They were not interviewed either because they were inaccessible or because of the weather.

Table B.18. Angler type

Type of angler	Frequency	Percent
Shore	83	88%
Boat	11	12%

Table B.19. Angler's city of residence

City of angler residence	Frequency	Percent
Allegan	19	20.2%
Alto	2	2.1%
Battle Creek	4	4.3%
Bellwood, IL	1	1.1%
Cadillac	1	1.1%
Chicago, IL	1	1.1%
Covert	2	2.1%
Delton	1	1.1%
Fennville	12	12.8%
Flint	1	1.1%
Galesburg	1	1.1%
Grand Rapids	4	4.3%
Hastings	2	2.1%
Holland	2	2.1%
Kalamazoo	12	12.8%
Paw Paw	1	1.1%
Portage	2	2.1%
Pullman	15	16.0%
Rochester	1	1.1%
Saugatuck	3	3.2%
Schaumburg, IL	1	1.1%
South Haven	5	5.3%
Unspecified	1	1.1%

Figures may not sum to 100% due to rounding.

Table B.20. Prior interview for this survey

Have you been interviewed previously for this survey?	Frequency	Percentage
No	87	92%
Yes	7	8%

Table B.21. Number of respondents targeting each species^a

Species targeted	Upper		Central		Lower	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Trout	0	0%	0	0%	2	3%
Salmon	1	33%	0	0%	28	38%
Walleye/pike	0	0%	2	11%	11	15%
Perch/bluegill/sunfish	0	0%	4	22%	12	16%
Bass	2	67%	2	11%	5	7%
Carp/catfish/sucker	0	0%	2	11%	13	18%
Whatever is biting	3	100%	13	72%	41	56%

a. Number of times each species was mentioned as targeted; individual respondents can target more than one species per trip so totals may not equal 100%.

Table B.22. Number of anglers in party

Number of anglers in party	Upper		Central		Lower	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
1	1	33%	12	67%	42	58%
2	2	67%	6	33%	20	27%
3	0	0%	0	0%	7	10%
4	0	0%	0	0%	4	5%

Table B.23. Days spent fishing in past 2 weeks, including the day of the interview

Days spent fishing in past two weeks	Upper		Central		Lower		All	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	1	33%	10	56%	16	22%	27	29%
2	1	33%	2	11%	16	22%	19	20%
3	0	0%	3	17%	9	12%	12	13%
4	1	33%	2	11%	17	23%	20	21%
5	0	0%	0	0%	2	3%	2	2%
6	0	0%	0	0%	5	7%	5	5%
7	0	0%	0	0%	3	4%	3	3%
8	0	0%	0	0%	0	0%	0	0%
9	0	0%	1	6%	2	3%	3	3%
10	0	0%	0	0%	0	0%	0	0%
11	0	0%	0	0%	1	1%	1	1%
12	0	0%	0	0%	0	0%	0	0%
13	0	0%	0	0%	0	0%	0	0%
14	0	0%	0	0%	2	3%	2	2%

Table B.24. Days spent fishing in other locations in past 2 weeks^a

Days fished at other rivers/lakes in past two weeks	Rabbit River		Gun River		Muskegon Lake		Duck Lake	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
0 ^b	90	96%	92	98%	93	99%	93	99%
1	1	1%	2	2%	1	1%	1	1%
2	1	1%	0	0%	0	0%	0	0%
3	2	2%	0	0%	0	0%	0	0%

a. 0 fishing days reported for Battle Creek.

b. For example, 90 anglers reported they had not fished the Rabbit River in the last two weeks (but four had, at least once), 92 reported they had not fished the Gun River in the last two weeks (but two had, one time each), and so forth.

Table B.25. Attractive features of angling location (listed options)

Things you particularly like about fishing here (listed options) ^a	Upper		Central		Lower	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Convenience	2	67%	12	67%	32	44%
Uncongested	1	33%	3	17%	14	19%
Accessibility	0	0%	4	22%	16	22%

a. Respondents can provide more than one response or no response so totals may not equal 100%.

Table B.26. Things you particularly dislike about fishing here (listed options)

Unattractive features of the location (listed options) ^a	Upper		Central		Lower	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Consumption restriction	0	0%	0	0%	0	0%
PCBs	0	0%	2	11%	6	8%
Other visible pollution	0	0%	5	28%	18	25%
Limited access	0	0%	0	0%	1	1%

a. Respondents can provide more than one response or no response so totals may not equal 100%.

Table B.27. Other likes and dislikes (open-ended)

Reach ^a	Likes	Dislikes
Central	Nice area to fish No snakes, quiet location	Near neighborhoods Snakes Traffic near lake (x2)
Lower	Good fishing site (x3) Many fish (x4) Nice area (x2) Diverse fish Not chaotic as Allegan Dam Peaceful at times Water is shallow	Crowded (x9) Can be rowdy (x2) Dirty water Not enough catches (x2) Lot of snags (x2) People for steelhead run River's reputation Too much traffic Stairs along dam dangerous

a. No other responses were received from anglers interviewed in the upper reach of the KRRRA study.

Table B.28. Are you aware of advisories for this stretch of river?

	Upper		Central		Lower		All	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Yes	3	100%	7	39%	29	40%	39	41%
No	0	0%	8	44%	27	37%	35	37%
Uncertain	0	0%	3	17%	17	23%	20	21%

Figures may not sum to 100% due to rounding.

Table B.29. What do you understand the advisory in this stretch to be (open-ended)?

Upper
Do not eat bass and bottom feeders.
Fishermen receive information with license – do not eat most fish.
Central
A person can only eat certain numbers of certain types of fish.
Eat once per week.
If you're male, you can eat bass twice a week, avoid others.
It is safe to not eat the fish.
Only bottomfeeders, not bass.
Only eat particular species.
Women and children do not eat the fish.
You are not supposed to eat fish anywhere in the river.
Lower
I know the fish consume PCBs in river.
Allowed to eat some, others will make you sick.
Aware of FCAs.
Cannot eat carp or catfish.
Do not eat any fish.
Do not eat bass, bottom feeders only.
Do not eat catfish.
Do not eat certain types.
Do not eat them.
Eat a few kinds of fish only a couple times a week.
Eat catfish and bottomfeeders only – once a week.

Table B.29. What do you understand the advisory in this stretch to be (open-ended) (cont.)?

Lower (cont.)
Eat fish once a month.
Eat fish once to a few times each week depending on fish.
Eat once a month – only some fish.
Eat one fish a week.
Eat the fish once a week.
Heard and read about FCAs.
Heard of contaminated fish in river.
Many fish you are not allowed to eat.
Men can eat specific types of fish.
Men only eat a few each week, women and children do not eat.
Men eat small amounts – women and children cannot eat fish.
Not sure.
Only eat bass.
Only certain types.
Nasty water – salmon do not live in water – free to eat.
Some fish are dangerous to eat – catfish.
Stay away from bass, eat bottomfeeders.
There are many types you cannot eat.
Understand FCAs.
Watch types you eat – can only eat on occasion.
Water is polluted, not all fish are safe to eat.
Only certain fish, certain times per month.

Table B.30. Distribution of responses for percentage of fish caught that are eaten

Reach	Percentage of fish caught that are eaten	Frequency	Percent of total responses in reach
All reaches combined	0%	49	52%
	5%	3	3%
	10%	20	21%
	20%	9	10%
	30%	3	3%
	40%	2	2%
	50%	3	3%
	100%	5	5%
Upper Kalamazoo	0%	1	33%
	20%	1	33%
	30%	1	33%
Central Kalamazoo	0%	13	72%
	5%	1	6%
	10%	3	17%
	20%	1	6%
Lower Kalamazoo	0%	35	48%
	5%	2	3%
	10%	17	23%
	20%	7	10%
	30%	2	3%
	40%	2	3%
	50%	3	4%
	100%	5	7%

Table B.31. Average percentage of fish caught that are eaten

Reach	Number of responses	Average percentage of fish caught that are eaten
All reaches combined	94	13%
Upper Kalamazoo	3	17%
Central Kalamazoo	18	3%
Lower Kalamazoo	73	15%

Table B.32. Angler age group

	Frequency	Percent
Youth	5	5%
Adult	78	83%
Senior	11	11%

Figures may not sum to 100% due to rounding.

Table B.33. Angler gender

	Frequency	Percent
Male	77	82%
Female	17	18%